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For Each to Excel

What Neuroscience Says About Personalized Learning

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Discoveries about the brain can help teachers individualize learning. But first we must sort the truth from the hype.

Designing educational experiences without an understanding of the brain is like designing a glove without an understanding of the human hand. This analogy is attributed to Leslie Hart, pioneering author on brain-compatible learning in the 1980s. Since Hart made this analogy, there have been many advances in scientific understandings of how the brain operates. Teachers who are passionate about reaching students should be eager to use advances in neuroscience to design better educational experiences.

However, besides the spread of reputable findings, many misleading overgeneralizations about learning and the brain have been promoted. Half-truths—sometimes labeled "brain-based learning"—that don't have a solid foundation in research have been incorporated into products and trainings. Brain-based learning is a term many scientists and educators now avoid because they believe it indicates an approach to learning that's more commercial than scientific. Because of the mixed quality of information, teachers who are committed to personalizing learning find the promises of "brain-based" strategies or even of a "better brain" confusing.

What Is Mind, Brain, and Education Science?

Mind, Brain, and Education science, which links cognitive neuroscience, education, and psychology, has implications for personalizing learning. Its findings can help learning professionals better diagnose a student's learning challenges and individual needs by narrowing down the types of problems a student may be experiencing.

This greater diagnostic precision is one of the chief benefits of drawing on neuroscience for education. For example, we now know that there are at least 12 different neural networks in the brain related to reading. Spelling, processing metaphors, understanding symbol-to-sound relations, intonation, and other aspects of reading are each processed differently in the brain. A teacher who understands that different parts of reading are processed differently in the brain would be better able to devise learning intentions crafted to students' individual needs.

Sorting Good From Bad Information: Four Categories

But teachers need help to separate good information from bad. To help teachers more easily sort reliable (evidence-based) from less reliable (nonscientific) information, Mind, Brain, and Education science has divided learning concepts connected to this field into four main "quality categories": (1) well-established information, (2) information that is probably so, (3) intelligent speculation, and (4) neuromyths. This division of concepts has been around since the Organisation for Economic Cooperation and Development (OECD) published Understanding the Brain: The Birth of a Learning Science in 2002. In that year, in a series of meetings around the globe, representatives of the 30 countries in the OECD agreed on the quality categories and on which learning concepts belong in each category. The categories have only recently been shared with a general audience.

A full description of where recent claims about the brain and education fall in these categories is beyond the scope of this article. But let's look briefly at these four categories, what kinds of information are characteristic of each, and some implications for teachers striving to apply discoveries in neuroscience sensibly.

Well-Established Information

For a concept to be considered well-established in Mind, Brain, and Education science, several studies from all three parent fields (neuroscience, psychology, and education) must support the concept. These concepts tend to be true for all human beings. For example, plasticity is a well-established concept that explains how human brains make new connections, sometimes in response to loss of a brain structure or function and sometimes to forge new connections, as in classroom learning.

This category also includes the belief that human brains are as unique as human faces, and that, unfortunately, all brains are not created equal, nor can every brain approach all tasks successfully. It's also well established that all new learning passes through the filter of past experience. Grasping these concepts helps teachers understand why authentic learning experiences that are relevant to a learner's own life help facilitate learning.

"Probably So" Information

Information categorized as "probably so" has lots of backing in the three parent fields but is often of such a personalized nature that it's either difficult to prove the information or to make useful generalizations on the basis of it. For example, everyone agrees that sleep is important for learning. Research in neuroscience and psychology, however, has revealed that individual sleep patterns are different, making it impossible to generalize advice about how much sleep is necessary. Robert Stickgold (2005) at Harvard University has documented the importance of sleep in memory consolidation, but acknowledges that not everyone needs exactly eight hours to function properly. Sleeping anywhere between 4.5 and 12 hours is "normal." Some people who have trained themselves to "power nap" and get into REM sleep faster are more efficient in using sleep to improve memory and attention, both fundamental to new learning.

It's also considered probably true that people judge one another's faces and tones of voice almost immediately—and unconsciously. This information has implications for teacher effectiveness and student engagement. If a teacher's facial expression and tone lead students to quickly and unconsciously conclude that this teacher has a low sense of self-efficacy, these learners may doubt the quality of the teacher even before a lesson starts. Or a student may misinterpret a teachers' tense expression as condescending—and research shows that what students think their teachers think about them influences those students' performance, even if this perception is incorrect.

It's important for teachers to be conscious of the messages they send students, intentional or not. The best way to improve nonverbal communication and manage our tones of voice correctly is to invite review. As shown in The Teaching Gap (Stigler & Hiebert, 2009), teachers who study video footage of themselves or get feedback from peers improve their classroom instruction.

Another concept in this category is that teaching can be strengthened by taking advantage of the tendency for the human brain to quickly detect novelty in the environment. Our brains are primed to notice unexpected movements, sounds, or other sensory input that are out of the ordinary and to develop categorization schemes. This includes changes in expected patterns, such as in word or numerical sequencing. Teachers can take advantage of this novelty-sensing tendency by varying classroom methods to engage individual students. However, this tendency is influenced by personal experiences (people of varied backgrounds find different things "novel"), so it's hard to generalize advice for the classroom.

Intelligent Speculation

Intelligent speculations are those concepts that at first blush seem obvious, but upon further digging, lack supporting evidence. For example, a popular concept classified as intelligent speculation is that boys' and girls' brains are different. It might seem obvious that males' and females' brains differ because their bodies differ. But neuroscience has shown that boys' and girls' brains are more than 99 percent alike, noting only four physiological differences, none of which has been linked to behavioral differences between the sexes. As Fine (2011) points out in her review of much of the literature on gender difference, highlighting differences between boys and girls is a popular concept that sells easily, but it is shallow in terms of evidence. Although there's a great deal of research showing the effect of different hormones on behavior, and the brain does control hormone levels, brains themselves don't differ greatly by gender.

This lack of evidence for gender differences has bearing on the best way to individualize learning. Neuroscience indicates there is greater variation among female brains (or among male brains) than there is between male and female brains; therefore, teachers are better off differentiating instruction according to the particular strengths and needs of the entire class population than differentiating by gender.

Another concept still categorized as intelligent speculation is that enriched environments help children learn better. Although enrichment sounds like a good idea, an environment can only be defined as enriched relative to some less stimulating environment. Because teachers can't know how stimulating—or how lacking in stimulation—each students' household is, it's unclear how teachers might design classrooms that are unarguably "enriched" for each child.

Neuromyths

Concepts in this last category are dangerous overgeneralizations about the brain that are based on little or no research. These misconceptions may originate in some sub-element of sound science; but as conclusions they are incomplete, or they reach beyond the evidence. Teachers should avoid rooting any decisions about teaching practice in these concepts or using resources heavily based on them. Discussions about the "right brain" and "left brain" belong here. This concept has been the target of thousands of books and articles, some of which promote the term, but most of which criticize the lack of factual accuracy of the claim. Unsubstantiated claims about how to "teach to the right brain," for instance, are now being shattered by the Mind, Brain, and Education science movement. People only have one brain, which works in a highly complex way that can't be simplified into statements on "localizationism."

Other neuromyths include the concept that there are critical periods in life when certain subjects must be taught and learned (or they can't ever be learned) and the concept that humans use only 10 percent of their brains.

These categories help teachers become more cautious consumers of information, who can apply knowledge about the brain to personalizing instruction more effectively. More educators, psychologists, and cognitive neuroscientists are embracing the goal of improving teaching by basing it on evidence. Better guides are now being published in the field of Mind, Brain, and Education science. (See "Suggested Readings in Mind, Brain, and Education Science.")

First, Do No Harm

By letting teachers know which claims on learning and the brain are well supported, neuroscience is keeping teachers honest. Half-truths about the brain and overgeneralizations on how the brain reacts to stimuli (such as to music or "brain gym" early in a child's life) are being put into their rightful place as either speculation or myth. Teachers are setting aside poorly substantiated commercialized ventures, and more accurate information to improve our practice is now replacing questionable trends.

I believe teachers and doctors should share the same first rule: Do no harm. When you go to the doctor, at a minimum you expect that he or she won't make your health worse. Similarly, when parents send their children to school, they hope their children won't return with less motivation to learn or with false ideas about their brain's limited capacity.

Teachers will be more likely to do no harm if they look to claims about the brain—and the implications of those claims for personalizing learning—that have been judged reputable by scientists and not by the popular press.

References

Fine, C. (2011). *Delusions of gender: How our minds, society, and neurosexism create difference*. New York: Norton.

Stigler, J. W., & Hiebert, J. (2009). *The teaching gap*. New York: Free Press.

Stickgold, R. (2005). Sleep-dependent memory consolidation. *Nature, 437(7063)*, 1272-1278.

Suggested Readings

These are a few of the many good guides to Mind, Brain, and Education science

Books

- *Mind, Brain, and Education Science: A Comprehensive Guide to the New Brain-Based Teaching*. By Tracey Tokuhama-Espinosa. (2010). New York: W.W. Norton.
- *The Educated Brain: Essays in Neuroeducation*. By Antonio Battro, Kurt W. Fischer, and Pierre J. Lena (Eds). (2008). Cambridge, UK: Cambridge University Press.

Articles

- "Applying Neuroscientific Findings to Education: The Good, the Tough and the Hopeful." By Kalina Christoff. (2008). *Mind, Brain, and Education, 2*, 55–58.
- "Mind, Brain, and Education: Building a Scientific Groundwork for Learning and Teaching." By Kurt W. Fischer. (2009). *Mind, Brain, and Education, 3*(1), 3–16.
- "Educator's Views on the Role of Neuroscience in Education: Findings from a Study of UK and International Perspectives." By Susan Pickering and Paul Howard-Jones. (2007). *Mind, Brain, and Education, 1*(3), 109–113.

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Education Science in the Classroom (Teachers College Press, 2009).
